

REMARKS

Claims 1-20 are pending in the present application. In the Office Action mailed March 22, 2006, the Examiner rejected claims 1-5 under 35 U.S.C. §102(b) as being anticipated by LeRoux et al. (USP 5,345,176), hereinafter referred to as LeRoux. The Examiner next rejected claim 6 under 35 U.S.C. §103(a) as being unpatentable over LeRoux in view of Loncar et al. (USP 6,252,400), hereinafter referred to as Loncar. Claim 7 was rejected under 35 U.S.C. §103(a) as being unpatentable over LeRoux in view of Alsop's "The Sensitivity of Low Flip Angle RARE Imaging," hereinafter referred to as Alsop. Claim 8 was rejected under 35 U.S.C. §103(a) as being unpatentable over LeRoux, Stuber et al. (USP 6,230,039), hereinafter referred to as Stuber.

The Examiner withdrew claims 9-20 as allegedly drawn to a nonelected invention. Applicant respectfully requests reconsideration of the restriction requirement in light of amendments to claim 1 as discussed below. In the restriction, the Examiner stated that claims 1-8 are distinct from claims 9-20 because "the MRI apparatus can be used to practice another materially different process such as a method of MR imaging wherein the flip angle is determined without the use of a maximum echo amplitude equal to a target/desired amplitude." That is, the MRI apparatus has a flip angle that is obtained with the use a maximum echo amplitude substantially equal to a target amplitude. As such, the Examiner's example of using the apparatus of claims 1-8 in a process "materially different" from claims 9-20 is rendered moot. Therefore, Applicant believes that claims 9-20 should be rejoined and examined in the present application.

The Specification was objected to because of informalities. The Examiner suggested that reference number 90 on pages 8 and 9 should be 96. The Specification has been amended, in Paragraphs 32 and 33 to make reference instead to curve "97" in accordance with the change to Fig. 3 below.

The Drawings were objected to as failing to comply with 37 CFR 1.84(p)(4) because reference character "96" has been used to designate both "the end" in Fig. 2 and the curve of Fig. 3. Applicant has corrected this error and Figure 3 has been amended with reference number "90" changed to "97."

Claim 4 has been amended to correct the antecedent "a majority of echoes" with "the majority of echoes."

The Examiner rejected claims 1-5 under 35 U.S.C. §102(b) as being anticipated by LeRoux. Claim 1 has been amended to clarify that the computer is programmed to determine, in real-time, a respective flip angle for each data acquisition pulse of a pulse sequence for multi-

echo acquisition of MR data matched to a given target tissue, with known T1 and T2, and a given scan prescription such that a target amplitude for a majority of echoes in the multi-echo acquisition is substantially uniform and a maximum echo amplitude of the majority of echoes is substantially equal to the target amplitude. Applicant respectfully submits that the applied reference does not teach or suggest one or more elements of the claimed invention. A careful reading of LeRoux reveals that LeRoux fails to teach or suggest that a target amplitude for the multi-echo acquisition is substantially uniform for a majority of the echoes in the echo train or that a maximum echo amplitude is substantially equal to the target amplitude.

LeRoux describes a technique for altering the nutation angles in successive RF refocusing pulses in order to stabilize the early NMR echo signals acquired during the RARE sequence. *LeRoux, Col. 2, lines 63-67.* LeRoux illustrates a rate of decay by dashed line 315 in NMR spin echo signals 301-304. *LeRoux Col. 7, lines 23-25.* LeRoux goes on to say that “the NMR echo signals 301-304 do not decay smoothly along dashed line 315.” *Col. 7, lns. 45-47.* LeRoux teaches that “the magnitude of the NMR signals 301-305 may oscillate significantly below this optimal T2 decay curve 315, particularly during the early NMR echo signals.” *LeRoux Col. 7, lines 45-49 (emphasis added).* LeRoux illustrates the oscillation effect in Figure 4 where, for a high tip angle of 180 degrees the oscillation “does not arise,” but when the tip angle is reduced below 180 degrees, the oscillations in the early NMR signal magnitudes become very significant. *LeRoux Col. 7, lns 56-63,* Furthermore, “[a]s the tip angle is further decreased, more NMR echo signals are affected before an equilibrium condition is reached, but oscillations become less pronounced.” *LeRoux, Col. 7, lines 60-66 and Fig. 4.* Finally, LeRoux states that “an objective of the present invention [is] to produce selective RF refocusing pulses which will eliminate such oscillations in the NMR echo signals for all spins in the excited slice.” *LeRoux, Col. 8, lines 9-12.*

Thus, LeRoux discloses an NMR system with pulse control means in which a series of NMR signals are stabilized from oscillation, the effect of which is illustrated in Figure 4 of LeRoux. LeRoux fails to disclose a computer programmed to determine, in real-time, a respective flip angle for each data acquisition pulse of a pulse sequence for multi-echo acquisition of MR data matched to a given target tissue and a given scan prescription such that a target amplitude for a majority of echoes in the multi-echo acquisition is substantially uniform and a maximum echo amplitude of the majority of echoes is substantially equal to the target amplitude.

Accordingly, that which is called for in claim 1 is not shown, disclosed, taught, or suggested in the art of record. As such, Applicant believes claim 1, and the claims which depend therefrom, are patentably distinct over the art of record.

The Examiner rejected claims 6-8 under 35 U.S.C. §103(a). Applicant respectfully disagrees with the Examiner with respect to the art as applied, but in light of claims 6-8 depending from what is believed otherwise an allowable claim, Applicant does not believe additional remarks are necessary and requests allowance of claims 6-8 based on the chain of dependency.

Claim 21 is newly presented. Applicant believes that the polynomial expressions that LeRoux disclosed are different from those of Applicant. The LeRoux polynomials describe signal amplitude at an echo being a function of flip angles, and are not dependent on tissue T1 and T2. On the other hand, polynomials claimed by Applicant describe flip angles as a function of echo number, and are dependent on the target tissue T1 and T2, as well as a given scan prescription. *Application, Paragraphs 33, 34, 40 and Fig. 6.* As such, Applicant believes claim 21 is in condition for allowance.

Further, Applicant believes that claims 9-20 also define over the art of record and because of the amendment to claim 1, claims 9-20 should be rejoined. Therefore, in light of at least the foregoing, Applicant respectfully believes that the present application is in condition for allowance. As a result, Applicant respectfully requests timely issuance of a Notice of Allowance for claims 1-21.

Applicant appreciates the Examiner's consideration of these Amendments and Remarks and cordially invites the Examiner to call the undersigned, should the Examiner consider any matters unresolved.

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Respectfully submitted,

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